Docket 50540

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT:	Brainard et al.		
U.S.S.N.:	09/870,243	Art Unit:	1752
FILED:	May 31, 2001	Examiner:	Sin J. Lee
FOR:	PHOTORESIST FOR IMAGING WITH HIGH ENERGY RADIATION		

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION

I, Robert L. Brainard, declare as follows:

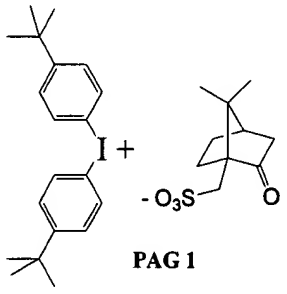
1. I am an inventor on U.S. patent application no. 09/870,243 assigned to the Shipley Company. I received a Ph.D. in Organic Chemistry from Massachusetts Institute of Technology in the United States and thereafter conducted post-doctoral research in the area of reaction mechanisms at Stanford University in California, United States. From 1987 to 1990, I was an employee of Polaroid Corporation doing research on the chemical sensitization of photosensitive emulsions. From October 1990 to the present, I have been employed by Shipley Company. From 1990 until 1991, I conducted research in the area of copper plating. From July 1991 until the present, I have conducted research in the areas of the design and development of photoresist compositions at Shipley. I am an inventor on two issued patents relating to photoresist compositions. My present job title with the Shipley Company is Principal Chemist.

2. I and other persons employed at the Shipley Company and working under my general supervision conducted the following experimental work. Thirteen photoresist compositions (referred to below and herein as Photoresists One through Thirteen) were prepared having resist composition as specified in Table A and B below. Resists 4 and 13 are identical to the resist described in Example 1 in U.S. patent application no. 09/870,243. Table A shows

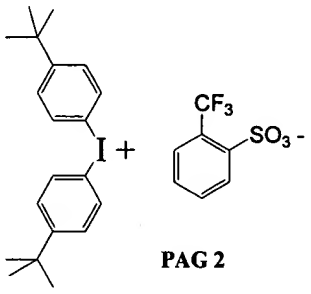
Resists One through Eight where polymer type, PAG type, PAG loading, base type, and base loading are varied. PAG structures are shown in Figure 1. These resists were coated to a film thickness of 100 nm and imaged with EUV (13.4 nm) radiation. Table B shows resists Nine through Thirteen show where PAG loading is varied from 2.5 to 8%. These resists were coated to a thickness of 125 nm for EUV exposure and to 500 nm for deep ultraviolet (DUV; 248 nm) exposure. Figure 2 shows DUV cross-sectional scanning electron micrographs (SEMs) for resists Nine through Thirteen imaged using DUV exposure.

Table A.

					EUV Imaging Results						
Resist	Polymer	Base Level Wt% TBAH	PAG Type	PAG Loading Wt%	100nm Dense E_{size}	Dense Rsln	Iso Rsln	100 nm LER	150 nm LER	200 nm LER	Average LER
1	65/20/15 PHS/Sty/TBA	0.4	PAG 1	5	8.5	80	60	9.4	10	9.2	9.5
2	65/20/15 PHS/Sty/TBA	0.4	PAG 1	8	6.5	90	60	10.4	11.7	10.8	11.0
3	65/20/15 PHS/Sty/TBA	0.4	PAG 2	5	7.8	80	60	5.8	7.2	5.9	6.3
4	65/20/15 PHS/Sty/TBA	0.4	PAG 2	8	5.9	80	60	6	6.8	5.5	6.1
5	65/15/20 PHS/Sty/TBA	0.125	PAG 2	2	4.6	85	80	33.3	33.6	42.4	36.4
6	65/15/20 PHS/Sty/TBA	0.125	PAG 2	5	2.0	95	50	13.7	10.1	12.1	12.0
7	65/15/20 PHS/Sty/TBA	0.125	PAG 1	2	6.5	90	70	61.8	57.4	14.6	44.6
8	65/15/20 PHS/Sty/TBA	0.125	PAG 1	5	5.2	80	85	12.5	9.4	13.1	11.7



PAG 1



PAG 2

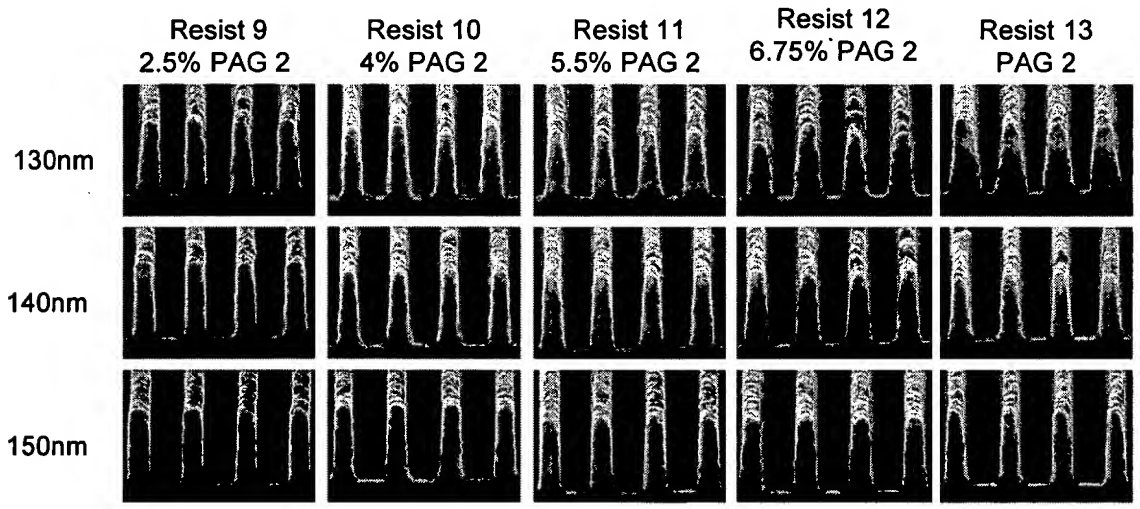
Figure 1. PAGs used in Resists One through Thirteen.

Table B.

				EUV Imaging Results				DUV Imaging Results				
Resist	Polymer	PAG 2 Wt %	Base	UFTL (Å)	Esize (mJ/cm²) 100 nm Dense	LER (nm, 3-sigma) 100 nm dense	LER Uncertanty (nm)	Esize (mJ/cm²) 150 nm Dense	Side-Wall Angle	Line Height (nm)	Profile Quality	Resolution (nm)
9	65/20/15 PHS/Sty/TBA	2.5% PAG 2	0.4%TBAH	196	19.2	6.5	1.5	36	88.7	459	Excellent	
10	65/20/15 PHS/Sty/TBA	4% PAG 2	0.4%TBAH	131	11.3	7.1	1.5	24	88.2	463	Excellent	
11	65/20/15 PHS/Sty/TBA	5.5% PAG 2	0.4%TBAH	97	8.9	6	1.1	20	87.7	459	Good	
12	65/20/15 PHS/Sty/TBA	6.75% PAG 2	0.4%TBAH	79	7.6	7.1	1.8	17	85.5	430	Poor	
13	65/20/15 PHS/Sty/TBA	8% PAG 2	0.4%TBAH	68	6.6	6.2	0.7	16.5	86.3	420	Poor	

Process Conditions: SB 130°C/60s, PEB 130°C/90s, 45s dev. MF-26A

Figure 2. Cross-Sectional SEMs of 130, 140 and 150 nm dense line/space pairs of Resists Nine through Thirteen after exposure with DUV light.



3. EUV E_{size} and EUV Line Edge Roughness (LER) values were determined for each resist and are shown in Tables A and B. Table A used GORA line edge roughness software and Table B used SUMMIT line edge roughness software. Furthermore, DUV imaging properties are shown in Table B for resists Nine through Thirteen. That data show the higher PAG loadings damage the imaging capability of DUV resists, yet improve the performance of EUV resists in terms of sensitivity and/or LER.

4. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application of any patent issuing therein.

Date: 7/22/04

Robert L. Brainard